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Firm Size and the Risk/Return Trade-off

by Amélie Lafrance

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r	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
E	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

Firm Size and the Risk/Return Trade-off

by

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Abstract

Is risk important in explaining differences in profitability across firm size classes? This study uses a longitudinal firm-level dataset to examine determinants of profitability by firm size, with an emphasis on risk, or the volatility in rates of return. It builds on previous research that found firms with 10 to 20 employees tend to be the most profitable. The results of a linear regression show that accounting for risk reduces the gap in rates of return between small and large firms, but does not eliminate it. The results of a quantile regression show that this is particularly the case for firms with the highest rates of return.

Executive summary

The topic of firm size and performance continues to spark the interest of researchers and policy-makers. Small and medium-sized enterprises receive much of the attention, as they have the potential to grow significantly. However, compared with their larger counterparts, these firms are more likely to fail and are therefore riskier.

Most studies examining firm size and profitability have found that larger firms tend to be less profitable than smaller firms. But their profitability is also less volatile than for smaller firms. Based on the argument that a risk-and-return trade-off may exist, it could be the case that higher rates of return in small firms just compensate for the higher risk in these firms.

Using three measures of risk—the standard deviation and skewness of individual rates of return over time, and the standard deviation of returns around the industry average—this study examines whether differences in profitability between small, medium-sized and large firms disappear when risk is taken into account.

Including the standard deviation in the distribution of return on assets over the 2000-to-2009 period in a linear regression reduces the differences in rates of return across firm sizes but does not eliminate it. Other factors than risk, as it is measured here, are associated with smaller firms' relatively high rates of return.

Because the distribution of return on assets across size classes tends to be positively skewed, a quantile regression method was employed to determine if the return on assets varies across size classes and across quantiles, and also, if the effect of risk varies by quantile. The results showed that, based on return on assets, firms with between 10 and 20 employees are more profitable than firms in other size classes across most quantiles, but particularly so in the upper quantiles—the group of firms that have the highest rates of return.

This analysis suggests that medium-sized firms have characteristics that distinguish them from other size classes. Notably, medium-sized firms have relatively lower debt-to-assets ratios.

1 Introduction

The association between firm size and performance continues to spark the interest of researchers and policy-makers. Small and medium-sized enterprises typically receive most of the attention, as they have the potential to grow significantly. However, they often face higher financing costs and are more likely than their larger counterparts to fail.

As demand for their product or service increases, firms typically grow. Whether firm performance, as measured by profitability, keeps up with the increase in size is addressed in this paper.

Results of previous studies of the association between firm size and profitability have been mixed. Diminishing returns to profitability with increasing firm size are commonly reported (Osborn 1950; Stekler 1964; Samuels and Smyth 1968; Neumann et al. 1979; Shapiro 1980). A recent Canadian study found an inverted u-shaped relationship between profit rates and firm size—profitability increased up to a certain size class (firms with 10 to 20 employees) and decreased thereafter (Lafrance 2012). This relationship prevailed in most industries and provinces.

An association between firm size, risk and return may also exist that accounts for this profitability/size relationship. Many argue that there is a risk-return trade-off; that is, higher rates of return are obtained only by taking on risk. Risk is often measured by the volatility in rates of return. For example, the capital asset pricing model (CAPM) (Sharpe 1964; Lintner 1965) is built on the notion that the riskier the stock, the greater the expected return. Thus, higher rates of return across size classes may just reflect less stable earnings and greater risk in smaller firms.

Compared with larger firms, small (and medium-sized) enterprises tend to take on more risk and to face more uncertainty. Lafrance (2012) found higher volatility of rates of return (on an intra-group basis and on an inter-temporal basis) for smaller firms, especially, the smallest. That analysis, however, was descriptive and did not directly examine the relationship between risk and return.

The present study investigates whether the differences in profitability by firm size disappear when risk, along with other factors associated with profitability, are taken into account using a multivariate framework. If the differences in rates of return do not disappear (or even get larger), smaller firms may have certain other characteristics that enable them to be more profitable than their larger counterparts.

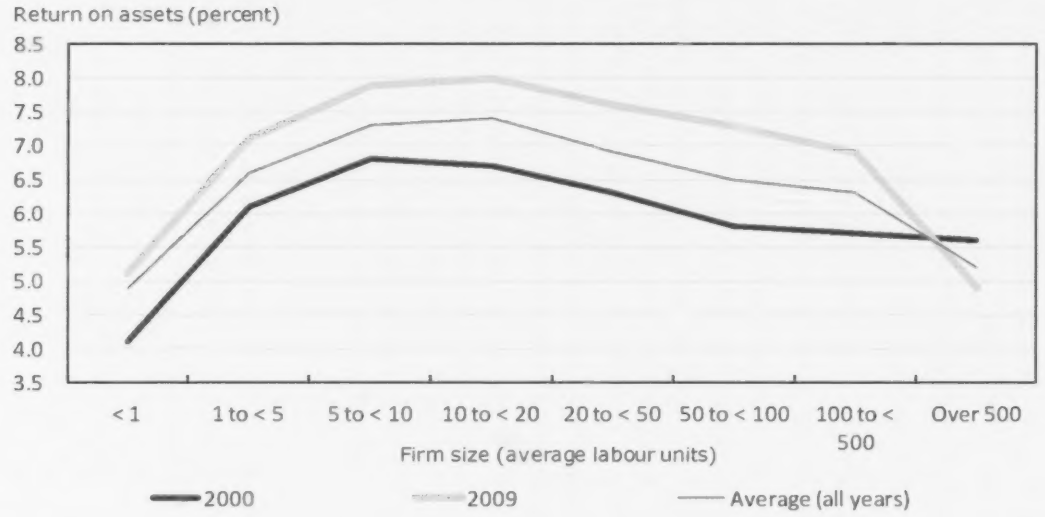
This paper uses multivariate analysis to examine the determinants of profitability by firm size, focusing on risk (or volatility in rates of return). It is organized as follows. Section 2 outlines the relationship between profitability and firm size. Section 3 describes the data sources and analytical models. Section 4 presents descriptive statistics. Section 5 presents the results from the linear regression model that examines how profitability is related to risk and other firm characteristics such as size and nationality. Section 6 presents the results from the quantile regression model. Section 7 describes differences in various characteristics across quintiles and size classes. Section 8 concludes.

2 Profitability and firm size

To provide some context, the main results of Lafrance's (2012) examination of the return on assets (ROA) across firm size classes over the 2000-to-2009 period are outlined here.

Chart 1

Mean return on assets, by firm size class, Canada, 2000, 2009 and 2000-to-2009



Sources: Lafrance (2012); Statistics Canada, Longitudinal Employment Analysis Program; and Canada Revenue Agency, Corporate Tax Statistical Universal File.

ROA followed an inverted u-shape, rising with firm size up to a certain threshold (firms with between 10 and 20 employees) and then decreasing (Chart 1). This pattern prevailed in both 2000 and 2009, and on average over the entire period. As well, the inverted u-shaped curve characterized most industries and regions, particularly those with the highest average profitability rates.

Lafrance (2012) also examined the relationship between ROA and the dispersion of earnings on an intra-group basis (within a size class) using the coefficient of variation in profit rates, and on an inter-temporal basis using the standard deviation in individual firms' rates of return over the period. Both measures showed that the smallest firms had the highest variation in ROA. Firms in the medium size class, which have the highest ROA, tended to have relatively low variability in their rates of return. Intra-group variability in ROA was lowest for the largest firms.

In summary, the analysis uncovered a relationship between profitability and firm size, but also, variations in profitability by firm size. However, the paper did not address whether accounting for variations in profitability in a multivariate framework would reduce the differences in rates of return across size classes. The present study examines this question.

3 Data sources and analytical approach

The dataset used for this analysis is Statistics Canada's T2-LEAP longitudinal firm-level database, covering the 2000-to-2009 period. The dataset pertains to incorporated firms in Canada that hire employees. It contains detailed information from firm financial statements, including balance sheets and income statements, and a measure of employment that is used to calculate firm size.

This study builds on a model of risk and return developed by Fisher and Hall (1969), who argued that greater variance in the distribution of earnings implied greater risk and should lead to large risk premiums for risk-averse firms. This implies that earnings should be greater, on average, for firms with more variation in their earnings than for firms whose earnings vary relatively little. Fisher and Hall (1969) estimated the relationship between average rate of return and risk exposure, using various measures of risk.

This paper extends their model by also controlling for size and for other variables associated with a company's rate of return. The model is expressed as:

$$r_i^* = f\left(size_i, risk_i, concentration_j, diverse_i, foreign_i, ind_i\right), \quad (1)$$

where r_i^* is the average rate of return on assets for firm i over the 2000-to-2009 period; $size_i$ is the size of firm i; $risk_i$ is the estimated risk of firm i; $concentration_j$ is the degree of firm concentration in industry j; $diverse_i$ is the degree of diversification of firm i; $foreign_i$ is equal to 1 if the country of control of firm i is outside Canada; ind_i is a set of industry dummy variables that control for the industry of firm i, at the 2-digit North American Industry Classification System (NAICS). At issue is whether the coefficient on firm size changes once risk and other factors are introduced into the analysis.

Profitability is measured as return on assets (ROA), defined as net profit before taking after-tax interest expense into account,[1] divided by total assets. This is the conventional measure of profitability and is also an indicator of how efficiently a company manages its investments in assets and uses them to generate profits.[2]

Firm size is measured by employment, which is derived from LEAP, based on total payroll in a firm, divided by the average hourly earnings in the firm's industry according to the Survey of Payroll, Employment and Hours.[3]

The concentration of an industry can affect profitability if market power associated with industry concentration is manifested in higher rates of return. Industry concentration is usually measured as the percentage of market share in an industry that is captured by the leading firms in that industry, and is included here as a measure of the degree of competition in an industry. Some studies have found that profits decrease with the number of competitors (Hurdle 1974; Neumann et al. 1979; Shapiro 1980; McDonald 1999). An industry with many small firms is likely to have a low concentration ratio. For the present study, concentration is measured by the

1. Interest payments on loans are adjusted for the tax treatment using information compiled by the Canadian Tax Foundation.
2. Return on capital employed is an alternative measure of profitability. When the regressions were re-estimated using return on capital employed instead of return on assets, the results were qualitatively similar.
3. For more information on T2-LEAP and on how the employment measure is derived, see Lafrance and Leung (2009).

share in four-digit NAICS sales of the three leading firms, estimated every year over the 2000-to-2009 period.[4]

Diversification occurs when a company expands its operations or products into an industry that differs from its major business. Firms may diversify into other industries to gain market power, to take advantage of profitable opportunities for the re-investment of earnings, and to employ underused resources.[5,6] But diversification may also result in a loss of management control.[7] On average, firms with higher levels of diversification tend to be less profitable than those with lower levels of diversification (Montgomery 1994). The T2-LEAP file contains information about the three most dominant industries associated with a firm, based on the LEAP employment measure. For this study, if a firm has any employees in an industry outside its major industry (defined at the two-digit NAICS), it is defined as being "diversified."

Profitability may also be related to whether it is controlled domestically or abroad. Earlier work showed that foreign-controlled businesses in Canada often enjoyed higher productivity than did their domestic-controlled counterparts (Baldwin and Gellatly 2007). Using return on capital, Warren (2005) found that, during the 1990s, U.S.-controlled enterprises were generally more profitable than Canadian-controlled enterprises.

The T2-LEAP file does not contain information on country of control. Some of this information was taken from the Business Register Generic Survey Universe File (G-SUF), which is compiled from ownership schedules filed annually with Statistics Canada by corporations falling under the *Corporations Returns Act*. These are incorporated businesses whose gross revenues exceed $80 million, whose assets exceed $200 million, or whose long-term debt or equity owing to non-residents exceeds a book value of $1 million. Information for corporations that do not exceed these thresholds is obtained from administrative data provided by the Canada Revenue Agency (CRA) (Statistics Canada 2012).

3.1 Risk

This study aims to determine if accounting for risk in a multivariate framework that includes measures of risk weakens the relationship between firm size and rates of return. Various measures can be used to control for risk.

Fisher and Hall (1969) argued that greater variance in the distribution of earnings is indicative of greater risk. This measure has often been used in the literature on profitability and risk (Stekler 1964; Samuels and Smyth 1968; Hurdle 1974; Shapiro 1980). Fisher and Hall also measured risk as skewness in the distribution of earnings—positive skewness implies less risk exposure; negative skewness, more risk exposure, which should carry a larger risk premium.

Similar to Fisher and Hall (1969), these risk variables are calculated for the present analysis as:

$$\sigma_i = \left[\sum_{t=1}^{n} \frac{\left(r_{it} - \bar{r}_i\right)^2}{n} \right]^{1/2}, \qquad (2)$$

and

4. The Herfindahl index is another measure of concentration, calculated by summing the squared market shares of all the firms in an industry at the four-digit NAICS level. Regressions using this index, rather than the concentration ratio specified, yield qualitatively the same results.
5. Montgomery (1994) provides a detailed literature review of the main drivers of diversification.
6. Product diversification may also be a form of risk diversification.
7. Baldwin and Wang (2011) find that plants owned by firms in other industries tend to be divested more frequently.

$$S_i = \sum_{t=1}^{n} \frac{\left(r_{it} - \bar{r}_i\right)^3}{n\sigma_i^3}, \tag{3}$$

where r_{it} is the observed rate of return for firm i in year t; $\bar{r}_i$ is the average rate of return over the time t period for firm i; σ_i is the standard deviation of rates of return for firm i; S_i is the skewness in rates of return for firm i; and n is the number of years included in the sample. The sample is restricted to continuing firms over the 2000-to-2009 period.[8]

Fisher and Hall (1969) also estimated a second measure of risk—the standard deviation of firms' average rates of return from the average rate of return in the industry—arguing that it was pertinent to the risk a firm faced upon entry to an industry. The intra-industry measure of risk is calculated as:

$$\sigma_j = \left[\frac{\sum_{t=1}^{n} \sum_{i=1}^{m} \left(r_{it} - R_j\right)^2}{nm - 1} \right]^{1/2}, \tag{4}$$

where σ_j is the standard deviation of firm rates of return around the industry j average; R_j is the average rate of return in industry j; r_{it} is the rate of return of firm i in year t; n is the number of years in the sample; and m is the number of firms in industry j. The 4-digit NAICS industry classification is used.

Because the risk variables are estimated over time, the sample is restricted to firms that continued throughout the 2000-to-2009 period; that is, firms that were present in both 2000 and 2009.[9]

4 Descriptive statistics

Table 1 presents the descriptive statistics for each variable in the regression model, and additional variables that will be discussed later, by firm size class. The size classes are based on average labour units (ALUs), a measure of employment derived from a firm's payroll and average hourly earnings in the firm's industry. Because a firm's wage rate may be less than the industry average hourly earnings, firm size can be "less than 1" ALU for small firms. This group includes firms that began operations near the end of the fiscal year, and thus, can contain start-ups whose employee complement will appear less than 1 using the ALU measure. The other firm size classes are: 1 to less than 5 ALUs; 5 to less than 10 ALUs; 10 to less than 20 ALUs; 20 to less than 50 ALUs; 50 to less than 100 ALUs; 100 to less than 500 ALUs; and more than 500 ALUs.

Average return on assets (ROA) by firm size follows an inverted u-shape, increasing up to the 10-to-less-than-20 size class and decreasing for larger size classes (Table 1). ROA is lowest for

8. An alternative measure of risk often used in the CAPM finance literature (the covariance of a firm's rate with the total or market rate) was explored for this analysis, but was not statistically significant in the regression model and had little effect on the size coefficients.
9. It is possible for a firm to change size classes over the period. Thus, each firm's size class is determined by the mode from 2000 to 2009. Use of another metric, such as the average size over the period, did not affect the results.

the smallest firms ("micro firms"), a pattern that holds using other measures of profitability, including return on equity and return on sales (Lafrance 2012).

The various measures of risk present an inconsistent picture across size classes. The standard deviation and skewness of ROA are highest for the smallest firms, at 11.5% and 18.3%, respectively. The standard deviation of ROA falls steadily with firm size, while the skewness in ROA falls up to the 10-to-less-than-20 size class and then increases. The pattern in the skewness in ROA across firm size is similar to the inverse of the average ROA curve observed in Chart 1.

Table 1

Descriptive statistics of continuing firms, by firm size class, Canada, 2000 to 2009

	Firm size class (average labour units)							
	< 1	1 to < 5	5 to < 10	10 to < 20	20 to < 50	50 to < 100	100 to < 500	Over 500
				percent				
Mean return on assets	6.9	8.8	10.2	10.2	9.3	8.4	7.6	7.3
				number				
Risk								
Standard deviation[1]	0.115	0.115	0.104	0.095	0.082	0.074	0.075	0.070
Skewness[2]	0.183	0.120	0.075	0.051	0.058	0.091	0.084	0.138
Industry - Standard deviation[3]	0.027	0.029	0.030	0.030	0.030	0.029	0.029	0.029
				percent				
Concentration ratio	19.5	18.7	19.1	19.7	20.3	22.9	26.3	33.8
Diversification	0.1	0.3	0.7	1.3	2.6	4.5	10.4	36.7
Foreign control	0.2	0.2	0.5	0.9	2.0	5.3	15.4	39.3
Median sales growth	3.7	4.3	4.5	4.8	5.0	4.8	5.3	4.9
Median employment growth	5.4	4.4	3.7	3.8	3.3	2.9	3.1	1.9
Median debt-to-assets ratio	61.0	60.6	58.4	59.3	64.6	69.2	70.0	62.6

1. The standard deviation of rates of return over the 2000 to 2009 period. See Equation 2.
2. The skewness in rates of return over the 2000 to 2009 period. See Equation 3.
3. The standard deviation of rates of return around the industry average. See Equation 4.

Sources: Statistics Canada, Longitudinal Employment Analysis Program; and Canada Revenue Agency, Corporate Tax Statistical Universe File.

The standard deviation of ROAs around the industry average is around 3% across firm size classes. This indicates that, regardless of size, firms face a similar risk in terms of volatility.

Other factors that may be associated with profitability include industry concentration, diversification, and the degree of foreign ownership. In all instances, a higher ratio is observed for larger firms. Firms with more than 500 ALUs are in industries with a concentration ratio greater than 33%; firms with fewer than 20 ALUs are in industries where the ratio is less than 20%.

Diversification into an industry other than the firm's major business is also more common in larger firms—37% of the largest firms diversify. By contrast, the percentage of smaller firms with employees in industries outside the firm's major industry is 10% or less. The percentage of firms controlled by a foreign entity rises from less than 1% of firms with less than 1 ALU to almost 40% of firms with more than 500 ALUs.

Sales and employment growth and the debt-to-assets ratio are included among the summary statistics because they are hypothesized to affect firm profitability. Sales growth tends to increase with firm size, while employment growth decreases with firm size. Sales to labour ratios are a measure of labour productivity. Large firms thus have higher labour productivity—

probably because they make use of more capital per worker. The median debt-to-assets ratio, a measure of a firm's ability to back its debt with assets, is more than 60% for most size classes, and slightly below 60% for firms in the 5-to-less-than-20-ALU size grouping.

5 Linear regression

To examine the relationship between firm size, risk and ROA, stepwise estimates are presented in Table 2. All models are estimated for continuing firms over the 2000-to-2009 period using Ordinary Least Squares and include industry binary variables at the 2-digit NAICS. Model 1 contains only a set of binary variables for each size class and industry binary variables. As shown in the descriptive statistics in Section 4, ROA increases up to the 10-to-less-than-20-ALU size class. Firms in this size class have an ROA that is almost 4% higher than that of firms in the base category (the smallest firms—less than 1 ALU). Firms in the 5-to-less-than-10-ALU size class are not far behind, with an ROA 3.5% higher than that of the "micro" firms.

Models 2 to 4 include the full set of correlates described in the previous section and variables to control for risk. A higher industry concentration ratio is associated with a higher ROA. A 1% increase in industry concentration can yield up to a 2% increase in ROA.

Consistent with Montgomery (1994), in all the models, firms active (or operating) in an industry other than their major industry (diversification) have lower ROAs than do firms active in a single industry.

Models 3 and 4 suggest that the difference in the ROAs between foreign-controlled and domestic firms post 2000 is not statistically significant.

Table 2

Estimated coefficients from a series of ordinary least squares regression models of return on assets of continuing firms, Canada, 2000 to 2009

	Model 1		Model 2		Model 3		Model 4	
	estimate	p-value	estimate	p-value	estimate	p-value	estimate	p-value
Variables								
Size binary variables								
1 to < 5 ALUs	0.0203	0.0000	0.0203	0.0000	0.0209	0.0000	0.0175	0.0000
5 to < 10 ALUs	0.0353	0.0000	0.0379	0.0000	0.0388	0.0000	0.0310	0.0000
10 to < 20 ALUs	0.0367	0.0000	0.0416	0.0000	0.0428	0.0000	0.0329	0.0000
20 to < 50 ALUs	0.0291	0.0000	0.0370	0.0000	0.0381	0.0000	0.0267	0.0000
50 to < 100 ALUs	0.0206	0.0000	0.0305	0.0000	0.0311	0.0000	0.0202	0.0000
100 to < 500 ALUs	0.0122	0.0000	0.0226	0.0000	0.0233	0.0000	0.0120	0.0000
Over 500 ALUs	0.0073	0.0000	0.0217	0.0000	0.0218	0.0000	0.0083	0.0000
Risk								
Standard deviation[1]	...	...	0.2219	0.0000	0.2254	0.0000	...	...
Skewness[2]	...	...	...	...	0.0130	0.0000	...	...
Industry - Standard deviation[3]	...	...	...	...	...	...	2.9653	0.0000
Concentration	...	...	0.0224	0.0000	0.0204	0.0000	0.0147	0.0000
Concentration squared	...	...	-0.0527	0.0000	-0.0498	0.0000	-0.0295	0.0000
Diversification	...	...	-0.0048	0.0000	-0.0061	0.0000	-0.0068	0.0000
Foreign	...	...	-0.0008	0.6380	0.0003	0.8410	0.0022	0.2070
Constant	0.0578	0.0000	0.0352	0.0000	0.0335	0.0000	-0.0221	0.0000

	Model 1	Model 2	Model 3	Model 4
Diagnostic statistics				
Number of observations	2,731,280	2,731,280	2,731,280	2,731,280
R-Squared	0.0555	0.0806	0.0935	0.0691

... not applicable

1. Standard deviation of rates of return for firm i.
2. Skewness in rates of return for firm i.
3. Industry – Standard deviation of firm rates of return around the industry j average.

Note: ALU signifies average labour unit. Industry binary variables were included in all regressions. Base category is <1 ALU.

Sources: Statistics Canada, Longitudinal Employment Analysis Program; and Canada Revenue Agency, Corporate Tax Statistical Universe File.

All measures that are used here to measure risk have a positive and significant effect on ROA. The parameter estimate that is attached to the standard deviation of firm ROAs in Models 2 and 3 indicates that a one-unit increase in the standard deviation in rates of return is associated with a 22% increase in average ROA. The skewness in rates of returns also has a positive effect on ROA.

Of interest is whether the coefficients measuring the differences in profitability across firm size classes that were generated from Model 1 are reduced once these correlates, particularly risk, are added.

The difference in the size coefficients in Model 1, compared with Models 2 and 3, is notable, especially for the larger size classes, which is partially accounted for by the covariates in the model aside from risk. However, the differences in the size coefficients between Model 1 and Models 2 and 3 become larger as size increases. There is less of a decline in profitability as size increases beyond the 10 to 20 employee firm size class. Moreover, significance tests show that the coefficients on the 1-to-less-than-5 ALUs size class and the more-than-500 ALUs size class were statistically different in Model 1, but not in Model 2. Thus, accounting for risk, particularly measured using the standard deviation in firm rates of return, narrows, but does not completely eliminate differences in rates of return between small and large firms.

More importantly, although controlling for risk reduces differences in profitability between the smallest and largest firms, the middle size classes remain the most profitable. Accounting for risk helps to reduce differences in rates of return across size classes, but firms in the 10-to-20 employees group still, on average, have higher ROAs than do their larger counterparts. Therefore, as measured here, risk is important, but it does not fully explain differences in profitability across size classes.[10] It does narrow the differences between the tails (smallest and largest) of the firm-size distribution.

If risk and the variables typically expected to affect profitability cannot fully explain why medium-size firms have higher profit rates, other factors may be at work.

6 Quantile regression

Most regression models, including linear regression models, are centred on the mean (also known as conditional-mean models). They are best suited to estimate or predict the average value of a variable based on the values of several other variables. But because they assume that using averages is suitable, these techniques may not be appropriate for distributions with heavy tails, such as rates of return.

An alternative is quantile regression, which models conditional quantiles as functions of predictors (Hao and Naiman 2007). Quantile regression models the changes in the conditional quantile associated with a change in the covariates. With quantile regression, it is possible to focus on specific groups of a population, at the p'th quantile. The median regression, which also describes the central location of a distribution, is a special case of a quantile regression, estimated at the 0.5th quantile.

The sample examined in this paper consists of continuing firms between the 5th and 95th percentile based on ROA. However, the distribution of ROA varies across firm size classes (Chart 2). None of the distributions are normal. Most have larger right tails (are positively skewed). Thus, a conditional-mean regression may not be appropriate for this analysis, because 1) the means differ across size classes; and 2) the distributions are positively skewed. This, in turn, may help explain why controlling for risk has little effect on the variation in ROA across size classes.

A quantile regression that takes the distributions illustrated in Chart 2 into account is used to determine if ROA varies across size classes and across rate-of-return quantiles, and if the effect of risk varies by quantile. The regression is expressed as:

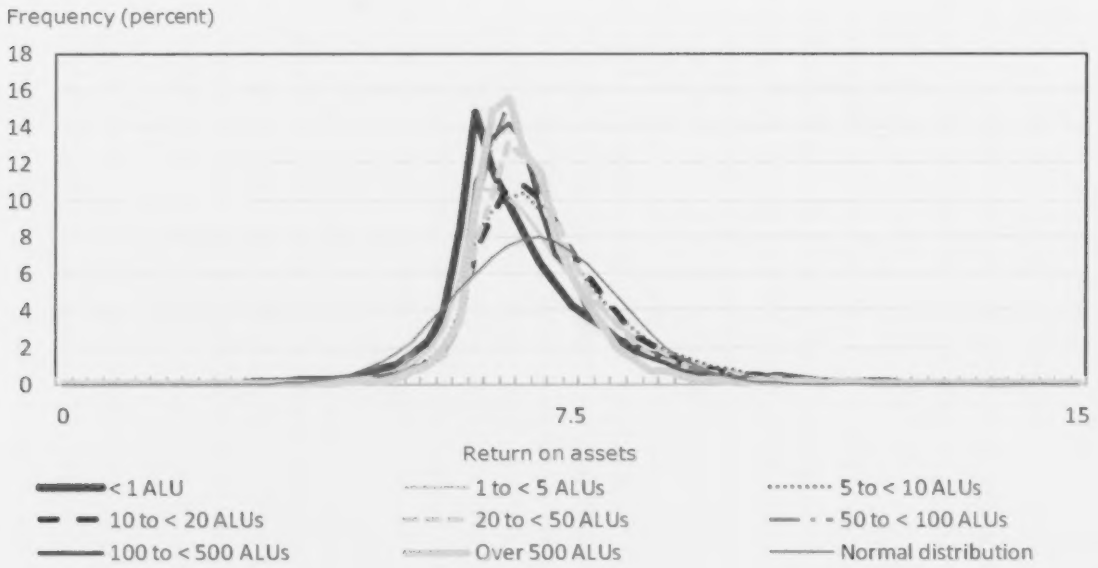
$$r_i^{\theta} = b_0^{\theta} + \sum_{s=1}^{8} b_{1s}^{\theta} Size_i + b_2^{\theta} risk_i + b_3^{\theta} Concentration_j + b_4^{\theta} Diverse_i + b_5^{\theta} Foreign_i + b_6^{\theta} Ind_i + u_i^{\theta}, \quad (5)$$

for $\theta = 0.05, 0.10, ..., 0.90, 0.95$. The subscript s represents the 8 size classes. The variables included in the regression are those in Equation 1. A total of 19 regressions are estimated.

10. To test the functional form, second moments of the risk measure were added to Model 3 (variance in the rate of return over time). This did not affect the conclusion, and thus, the results do not depend on the linearity of the functional form.

Chart 2

Distribution of return on assets of continuing firms, by firm size, Canada, 2000 to 2009



Note: ALU signifies average labour unit.
Sources: Statistics Canada, Longitudinal Employment Analysis Program; and Canada Revenue Agency, Corporate Tax Statistical Universal File.

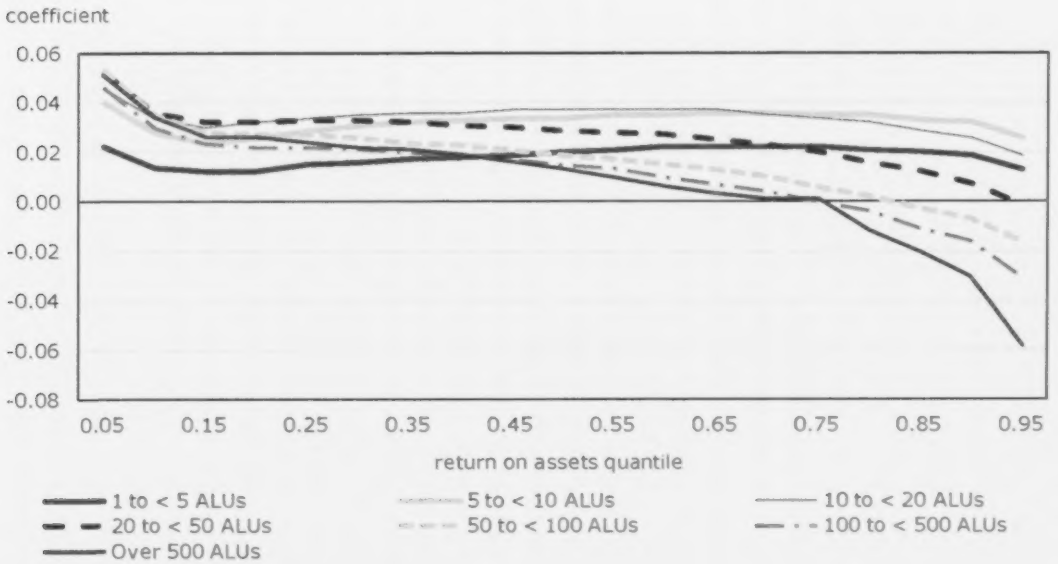
Two sets of quantile regressions are estimated. The first includes only a set of binary variables for each size class and industry binary variables, similar to the linear regression. The second is the full regression (Equation 5), using both the standard deviation of firm rates of return over time and the skewness in the rates of return as the measure of risk. The size-class coefficients are illustrated in Charts 3 and 4, where "ALUs less than 1" is the base size class. If a line lies above the horizontal axis that crosses at zero, the given size class has higher ROA compared with the base group at the given quantile; a line below the horizontal axis that crosses at zero represents lower ROA than the base group at the given quantile.

In the lowest rate-of-return quantile, little difference is apparent in the size class coefficients for firms with more than 5 ALUs (Chart 3). At higher quantiles, the difference widens, and in the top quantile, the spread between smaller and larger firms is greatest. Moreover, for the larger size classes, the coefficients decrease steadily with each quantile. Firms in the 5-to-less-than-20 ALU size class consistently have higher ROAs (more than 3% in most quantiles).

When the full set of covariates is included, a slightly different picture emerges (Chart 4). Aside from a general downward shift in the coefficients, little change occurs in the lower tail, or lower quantiles. At the upper tail, there is an upward shift in the coefficients. The differences in the coefficients at this end of the distribution are narrower than in Chart 3; in other words, accounting for risk and the other covariates reduces the gap in ROA between smaller and larger firms in the upper tail, but the gap persists. Moreover, firms in the 5-to-less-than-20 size classes have increasing coefficients across quantiles (the curve slopes upward).

Chart 3

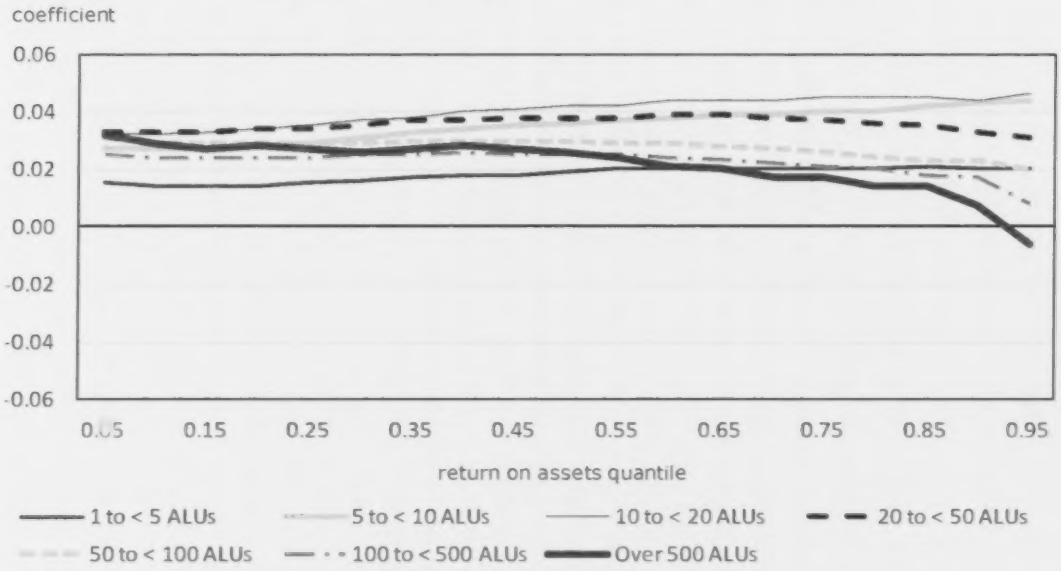
Estimated firm size class coefficients from quantile regression models of return on assets of continuing firms, firm size and industry dummies only, Canada, 2000 to 2009



Note: ALU signifies average labour unit.
Sources: Statistics Canada, Longitudinal Employment Analysis Program; and Canada Revenue Agency, Corporate Tax Statistical Universal File.

Chart 4

Estimated firm size class coefficients from quantile regression models of return on assets of continuing firms, full regression, Canada, 2000 to 2009



Note: ALU signifies average labour unit.
Sources: Statistics Canada, Longitudinal Employment Analysis Program; and Canada Revenue Agency, Corporate Tax Statistical Universal File.

These findings show that, based on ROA, firms in the smaller sized classes are more profitable than other size classes across most quantiles, particularly, the upper quantiles (the most profitable firms). At the lower end of the distribution, the differences across size classes are smaller. Firms in these size classes may have characteristics that firms in other size classes lack, and that are not related to risk, diversification or foreign ownership. These traits will be explored across quintiles (five percentiles based on ROA) in the next section, with a focus on the upper quintile, the group with the most pronounced differences in ROA by size class.

7 Characteristics of firms across quintiles

Descriptive statistics based on the complete sample of firms can provide inference that is less than ideal in some cases. To provide reasonable inferences, common metrics, such as averages, require that the majority of the data points be close to the center of the distribution, and that the tails of the distribution are reasonably well behaved. With non-standard distributions that may be skewed, be bimodal or multimodal, or have excess kurtosis, the use of common measures of centrality can mask important features of the distributions. One way to improve inferences is to dissect the distribution along its quartiles, and to examine statistical metrics for various segments of the distribution of interest.

In this section, various metrics for debt-asset ratios, market share, employment growth and sales growth are examined at different points of the return-on-asset (ROA) distribution. Specifically, the ROA distribution is divided into quintiles, and metrics are calculated for firms that fall into the first quintile (from 0 to the 20th quartile), the second quintile (from the 21st quartile to the 40th quartile), the third quintile (from the 41st quartile to the 60th quartile), the

fourth quintile (from the 61st quartile to the 80th quartile), and the fifth quintile (from the 81st quartile to the 100th quartile).

A debt-to-assets ratio indicates how effectively a firm can support its debt with assets. Across size classes, there were smaller differences in this value averaged over the period than there were across ROA quintiles. But there were large differences across size classes in how debt-to-asset ratios changed over time. In 2000, the largest firms in all ROA quintiles had the lowest debt-to-assets ratios, especially in the highest quintiles (Table 3). By 2009, the size-class difference was reversed, with the smallest firms having the lowest debt-to-assets ratio.

Across all ROA quintiles, firms with more than 500 ALUs acquired the most market share in terms of sales throughout the period. However, it is noteworthy that all firms in the upper quintiles (the most profitable) are those that gained rather than lost market share over the decade.

Sales growth generally increases with ROA quintile. In the lower quintiles, particularly, the second and middle, the larger size classes had the strongest sales growth over the period. However, in the highest quintiles, medium-size firms of between 10 and 50 ALUs had the most sales growth, averaging more than 7% per year.

Employment growth rises by ROA quintile, but generally decreases by firm size class. Smaller size classes, particularly firms with fewer than 20 ALUs, tend to experience higher employment growth (Dixon and Rollin 2012).

Several characteristics of very profitable firms (top quintile based on ROA) distinguish them from less profitable firms. They tend to have lower debt-to-assets ratios, reduced this ratio through the period and gained market share.

Table 3

Selected characteristics of continuing firms, by return on assets quintile and firm size class, Canada, 2000 to 2009

	Median debt-to-assets		Market share		Sales growth	Employment growth
	2000	2009	2000	2009	2000 to 2009	2000 to 2009
	ratio				percent	
Bottom quintile						
Size class						
< 1 ALUs	0.780	0.910	0.1	0.1	8.0	3.6
1 to < 5 ALUs	0.797	0.954	0.8	0.6	1.9	2.0
5 to < 10 ALUs	0.773	0.947	0.5	0.4	1.6	0.9
10 to < 20 ALUs	0.766	0.929	0.6	0.5	1.4	0.7
20 to < 50 ALUs	0.783	0.915	1.2	1.0	1.8	0.5
50 to < 100 ALUs	0.840	0.913	1.2	1.0	2.5	1.0
100 to < 500 ALU	0.821	0.913	2.7	2.3	2.7	1.3
Over 500 ALUs	0.739	0.879	14.7	9.8	1.5	-0.5
Second quintile						
Size class						
< 1 ALUs	0.737	0.626	0.1	0.1	3.5	5.3
1 to < 5 ALUs	0.751	0.680	0.8	0.7	3.3	3.5
5 to < 10 ALUs	0.742	0.698	0.7	0.6	2.9	2.3
10 to < 20 ALUs	0.720	0.693	1.1	1.0	2.9	2.2
20 to < 50 ALUs	0.745	0.711	2.5	2.4	3.1	1.9
50 to < 100 ALUs	0.775	0.742	2.4	2.3	3.3	1.9
100 to < 500 ALU	0.777	0.745	4.1	4.9	4.1	2.3
Over 500 ALUs	0.678	0.674	14.3	12.2	4.4	0.9
Middle quintile						
Size class						
< 1 ALUs	0.693	0.452	0.1	0.1	4.3	6.5
1 to < 5 ALUs	0.717	0.505	0.7	0.7	4.2	4.7
5 to < 10 ALUs	0.699	0.520	0.7	0.7	4.3	3.8
10 to < 20 ALUs	0.674	0.539	1.0	1.2	4.6	3.6
20 to < 50 ALUs	0.691	0.587	2.1	2.4	5.1	3.5
50 to < 100 ALUs	0.709	0.607	1.5	1.7	5.2	3.3
100 to < 500 ALU	0.733	0.627	3.3	4.0	5.9	3.7
Over 500 ALUs	0.630	0.581	15.8	17.6	5.5	2.6
Fourth quintile						
Size class						
< 1 ALUs	0.636	0.299	0.1	0.1	5.2	6.7
1 to < 5 ALUs	0.653	0.343	0.6	0.7	5.5	5.7
5 to < 10 ALUs	0.648	0.378	0.6	0.8	5.6	4.8
10 to < 20 ALUs	0.637	0.409	0.9	1.1	5.9	5.1
20 to < 50 ALUs	0.653	0.467	1.5	2.0	6.5	4.7
50 to < 100 ALUs	0.678	0.511	1.0	1.3	6.6	4.2
100 to < 500 ALU	0.664	0.509	2.4	2.8	7.3	4.0
Over 500 ALUs	0.567	0.488	12.4	12.8	5.7	3.3
Top quintile						
Size class						
< 1 ALUs	0.584	0.215	0.1	0.1	5.8	7.1
1 to < 5 ALUs	0.596	0.251	0.6	0.8	6.7	6.6
5 to < 10 ALUs	0.580	0.305	0.6	0.8	6.6	5.4
10 to < 20 ALUs	0.592	0.362	0.7	1.0	7.0	5.8
20 to < 50 ALUs	0.619	0.411	0.9	1.4	7.3	5.0
50 to < 100 ALUs	0.646	0.428	0.7	0.9	6.5	4.0
100 to < 500 ALU	0.625	0.448	1.4	1.7	7.1	4.1
Over 500 ALUs	0.573	0.463	2.6	3.3	6.7	4.7

Note: ALU signifies average labour unit.

Sources: Statistics Canada, Longitudinal Employment Analysis Program; and Canada Revenue Agency, Corporate Tax Statistical Universal File.

8 Conclusion

Previous studies in other countries of the relationship between firm size and rates of return often reported diminishing profitability for larger firms. Lafrance (2012) found that the profitability of Canadian firms initially increased and then declined across size classes. Profitability was highest for firms in the size class of 10 to 20 employees, which by most standards consists of relatively small firms.

Many small firms are likely to be in the growth stage of the life-cycle and, as a result, are more inclined to take on risk in order to compete. This paper examined whether this openness to risk explained the differences in profitability across firm size classes.

The literature has used various measures to account for risk, three of which were adopted in this study: the standard deviation and skewness of individual rates of return over time, and the standard deviation of returns about the industry average. A linear regression found that the inclusion of the standard deviation in the distribution of ROA over the 2000-to-2009 period led to the greatest reduction in differences in rates of return across firm size classes. Other factors associated with higher ROA were industry concentration and diversification.

Accounting for risk reduced the gap in ROA between small and large firms, but did not eliminate it. In other words, risk is important in explaining variations in profitability across firm size classes, but other factors are behind the relatively higher rates of return earned by smaller firms.

Because the distribution of ROA across firm size classes tends to be positively skewed, a quantile regression method was employed to examine how ROA varies across size classes and across quantiles, and if the effect of risk varies by quantile. The results showed that, based on ROA, firms in the 10 to 20 employee size class are more profitable than firms in other size classes across most quantiles, particularly, the upper quantiles.

These firms have characteristics that distinguish them from other size classes and possibly help them to outperform these other firms. They had relatively lower debt-to-asset ratios.

Discussions of differences in profitability are usually based on cross-sectional data at a single point in time or averaged over several periods to purge random movements from the dataset. As a result of changes in underlying fundamentals, firms change market share and relative position. They become more productive and innovative, and thereby, gain market share. This longitudinal analysis reveals that these changes are also associated with differences in profitability. The findings demonstrate that the firms in the top quintile of the profitability distribution in the post-2000 period are also the firms whose market share grew the most.[11]

11. Böbel, Haid and Neumann (1979) also find evidence that growth leads to higher profits, particularly for smaller firms. However, they did not examine this across quintiles.

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